Designing Gener-G, the Human Energy Trading Game

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ABSTRACT

Obesity is a serious problem and many government campaigns have highlighted the dangers of sedentary lifestyles (Ekblom-Bak et.al., 2010; Weiler et.al.,2010) and the benefits that regular physical activity can provide (Strong et.al.,2005; Weiler et.al.,2010). Young people require support to increase their physical activity, which should be encouraged early in life (Aarts et al, 1997).

Recently, a way to engage people is through games (Zyda, 2005). This paper highlights the value of making and prototyping in the design development process of 'Gener-G', an electronically augmented board game that encourages people to adopt more physically active behaviour through extrinsic motivation, as a means to gain rewards in the family, an important domain to intervene for promoting physical activity (Sallis et.al., 2006).

Gener-G is played in 2 stages: 1-accumulating energy by exercising during a specific period of time; 2-trading this energy through the board game. The energy generated in stage 1 is used as a currency for playing the board game in stage 2. Therefore, the quality and quantity of exercise in stage 1 influences the game in stage 2. The winner is the one with remaining energy points, and gains family based rewards.

Due to the technology involved in the game, iterative prototypes and simulations were created and tested during the development process, to get prompt feedback and to allow early detection of errors; saving costs and development time.
Even if the tests of Gener-G were conclusive, further development of the game itself is needed but also around the notion of continuous games. This is the intention of the next stage of the research; to explore in a participatory context how to attract and engage young adolescents on a long term basis in playing a game or a series of games to reach the recommended levels of physical activity.

INTRODUCTION

Obesity/Young People/Health
Over a billion people worldwide are overweight and at least 300 million obese (WHO, 2003). The number of obese children in Britain has tripled since the 1980's, to 23% of the population (Lister, 2005). Obese children have a 70% chance of becoming obese adults (NHANES, 2002) and evidence shows obesity negatively impacts young academic performance and long-term prospects in adulthood (Crimmins & Saito, 2001).
Obesity is a serious problem and government campaigns recommended that youths should accumulate at least 60 minutes of moderate to vigorous physical activity on most, if not all, days of the week (NASPE,2004). However, only 32% of adolescents aged 11-15 in England meet these recommendations and young people do require support to increase these levels (British Heart Foundation, 2009; Maddison et al, 2007).
This is partly due to the fact that physical activity has changed from a natural component of everyday life to something that we now need to choose to do as deliberate 'exercise' (Cavill & Bauman, 2004).
The Wolfenden Gap, reported in 1960s, has established that significant numbers 'flight from sport as soon as individuals left full-time education' (Roberts, 1996). More than 50 years later young people still drop off participation in sports after compulsory school (Green, 2006) starting of a lifelong decline in physical activity. New challenges appeared; society is more divided, young people are more diverse, have a culture of inactivity with 'busy' lifestyles (SMS, Facebook...), and 'exercise habits tend to wear off when entering adolescence' (Aarts et al, 1997). Young people require support to increase their physical activity, which should be encouraged early in life' (Aarts et al, 1997).

Gaming as an approach
Games are fun. This feature has recently been strategically employed to engage people in a range of issues (e.g. Health, Education...) through 'Serious Games' (Zyda, 2005). There has been important growth in the field of serious games for health (Kato, 2012), and Exergames (e.g.Wii Fit, Dance Revolution) is one category aiming to promote physical activity by increasing the energy expenditure when playing video games.
One such example is 'Gamercize' which links 'real exercise' with video games. In order to play games on the X-Box 360, players have to exercise using indoor equipment (stepper and/or bike) which is plugged to an intermediary device linking the exercise machine, the controller pad and the console. There has been a high focus on obesity through exergaming. However interventions so far haven't been shown to be effective (Elinder, 2005) and more research is needed on how the continuous dimension of game play and exercise can be combined and exploited to promote engagement and exercise on a regular basis.
In this case, it is about combining what young people like, what they would like to do, what they would not like to do – as an incentive to do what they should do, physical activity.

A PHYSICALLY ACTIVE GAME: 'GENER-G'

This research aims to find a way to educate and encourage the sustainability of the human body through a healthier lifestyle.

Concept
'Gener-G' is an 'electronically augmented' board game, for 2 to 4 players, designed for the family environment. The game is played in two stages:
1- Exercising over a course of time to accumulate energy stored in 'batteries'

2- Plugging these 'batteries' into a board game as 'energy' for each individual player. Hence the energy cumulated in the battery depends on the quantity of exercise done in stage 1. This can be used as an incentive to accumulate more energy in an attempt to acquire and advantage prior to stage 2. This energy used in stage 2 and regulated through dice can be traded, forfeited, multiplied and accumulated through the chance element of the board game.

The Winner
The winner is the last player in the game with remaining energy and has the opportunity to exchange his/her "family tasks" cards accumulated during stage 2 for the "benefits" cards won by other players. Through discussion and negotiation, the winner is allowed to trade bad cards for good ones hence avoiding household chores such as cleaning the table or watering flowers and enabling to secure enjoyable activities such as control of the TV.

Stage 1
To generate energy and charge up the batteries, set up the Generator (Figure A) as per instructions.
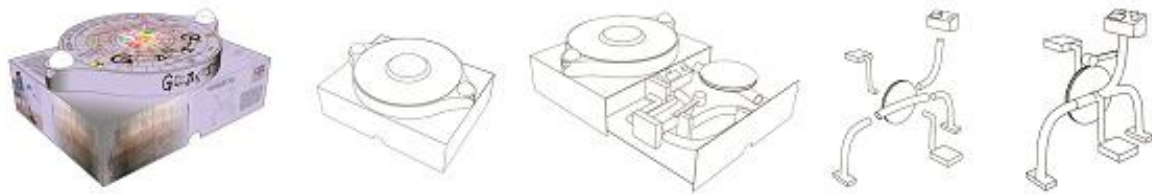
Figure A - The Generator included in the box

Stage 2
The energy generated by the players is then applied to the game. The board game element is composed of four concentric rings (Figure B).

Figure B

The outer ring contains more squares than the internal ones but has a greater proportion of 'lucky' and 'benefit' squares.

The game play in the board game is mainly based on elements of chance, risks and strategy to varying degrees. To maintain uncertainty of winning, two devices called 'Musical Boxes' ('Castanets' and 'Barrel Organ') are used through certain squares and allow players to accumulate a small quantity of energy during the game.

Hardware

The game includes the Generator, and all the required equipment is provided and distributed in the four drawers (Figure C). Each contains:

-A 'Castanet Musical Box'
-A 'Barrel Organ Musical Box'
-A set of 4 batteries and 4 tokens
-2 sets of cards (informative & currency) with a wipe clean marker pen and a set of blank, re-writable customisable cards.
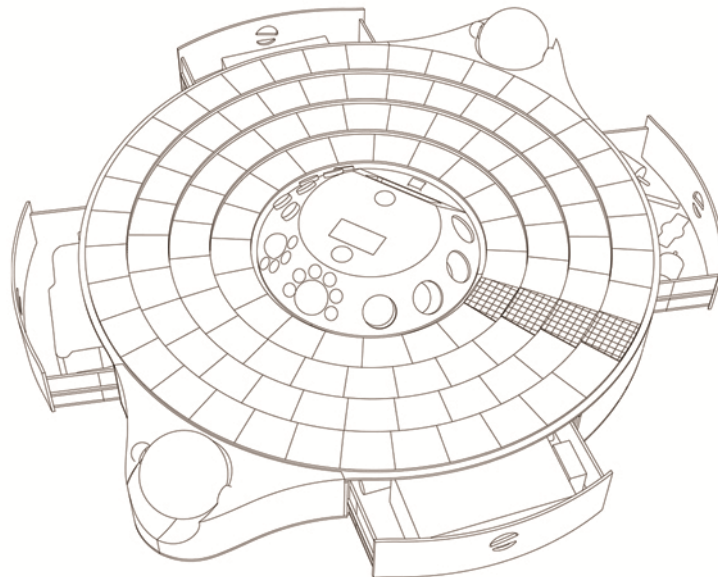

Figure C

To Start a Game on the Board

The player with maximum energy is player 1 and takes the outer ring. Once the batteries are plugged in the board game, player 1 starts by casting the Normal Dice (see 'Dice'). Players move their tokens in the anticlockwise (Figure D) to the number of spaces indicated by the Dice, and execute the required tasks for the space they land on.

Figure D

Dice
Each player in turn 'throws' the dice by spinning the clear ball on the game. There are 2 kinds of dice.
-The Normal dice, used to determinate how many squares to move the tokens
-The Jester dice (Figure E) used only when a player lands on the 'Jester square'. Each face has a different meaning ('Freeze', 'Move Forward/Backward', 'Red /Green Jester' & 'Blank').
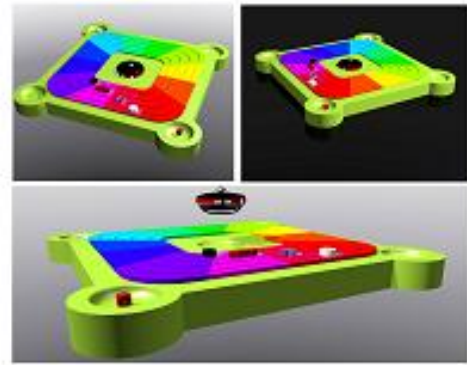

Figure E

ITERATIVE DESIGN PROCESS

Designing the Board Game
To arrive at the concept described above, there was a complex design development process. Several drawings and 3D modelling were produced to start building the game up (Figure F). The technology in the game was the starting point that guided the design of the game. In order to simplify the transfer of energy, all the electronics was gathered into the middle of the board, dictating that playing squares be laid out around this.

Drawing of what the game looks like...   ...and then its representation in 3D

Figure F

Figure G shows the emergence of different versions of physical prototypes with different levels of resolution. The designer evaluated these prototypes with colleagues and peers for initially feedback prior to presenting it to users (Houde & Hill, 1997).

(A) Visual Mock-Up   (B) Game Play Mock-Up   (C) Concept Prototype

Figure G

Following a rough determination of the technological requirements, a 'Visual Mock-Up' (A, Figure G) was built to get a sense of the board game proportions, which revealed it to be too big.
'Game Play Mock-Up' (B) (Figure G) was produced in order to test the game play and visual communication of the various elements of stage 2. This simulation model has been tested twice with groups of designers (Figure H). This audience can understand the intention of the trial and hence disregard to the low resolution of the model (e.g. use of matches to simulate real energy). Non-
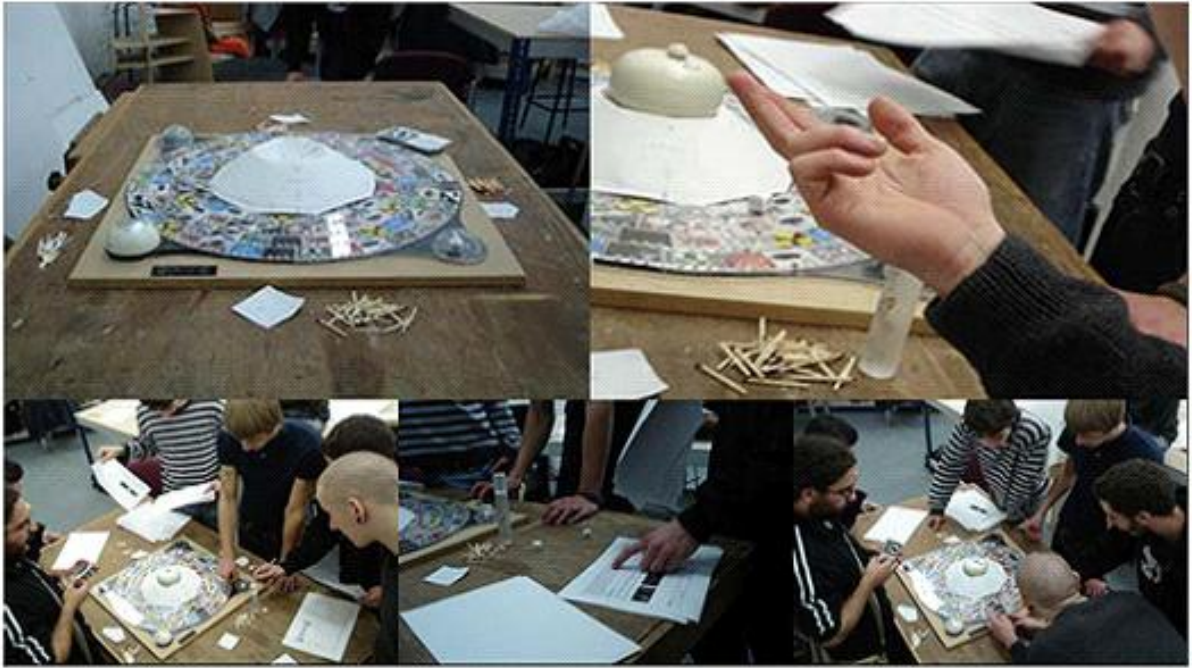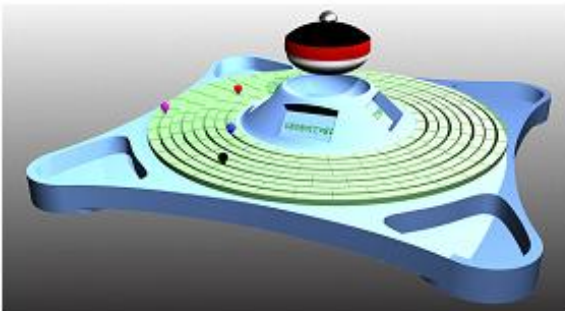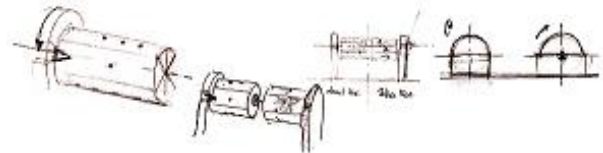
Figure H

designer groups of participants may not have understood this intention quite so easily. The approach of utilising low resolution models and testing reduces the expense and time and allowed to trial multiple modes, models and layouts economically.
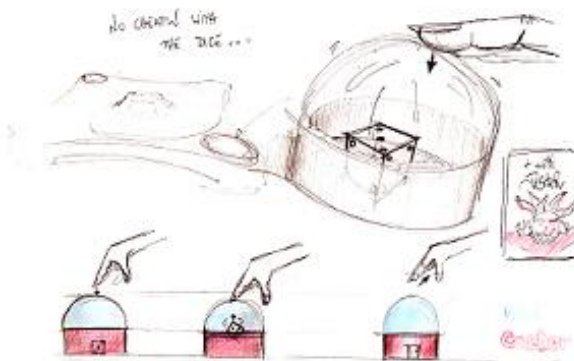
Designing the Hardware

The Jester dice is specific to this game design and their lost can be problematic. Ideas were considered to avoid this problem with a final solution of putting a dice in a clear sphere (Figure I).
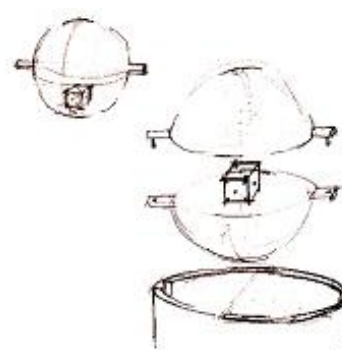

Dice is thrown in the cavity

Spin the rolls

Press the semi-sphere

Spin the sphere

Figure I

Similar to the Roulette, this has the potential to increase engagement when 'casting the dice' as players can see the dice rolling, increasing the suspense of what score will be.
Further tests of the components of the game were undertaken and low cost materials (here blue foam) were used to test the ergonomics of the various elements, enabling to explore many shapes of different forms.

Simulation after simulation, the game and its rules developed, with the elements becoming more clearly defined. Based upon the feedback of the prototypes presented previously, an 'Integration Prototype' (Houde & Hill, 1997) was built ((C) Figure G).

Every stages of test were crucial for the development of the game and it is only through a series of prototyping and testing that improvement and coherence in the design can emerge.

GENER-G IN CONTEXT

Practical test

Once this integration prototype built, another test was conducted over a week in a family environment (Figure J), enabling feedback from a user group for whom the game was originally designed for.

Figure J

Because the prototype was a simulation, physical activity was self-reported by the players when using the 'Generator'. According to these self-reported levels, a defined amount of energy using one, two, three and four AA batteries (from the least levels of physical activity to the most) was transferred into the right player's battery.

The researcher observed the play of the board game which was followed up by an interview with all the members of the family. The main feedback was that the concept was a good incentive for the players to do physical activity but needed improvements for both stages.

In stage 1, an alternative to the 'Generator' for generating energy should be considered. This was an original intention but rejected to avoid cheating (e.g. players can attach their battery onto their dog that will do the job for them). One solution would be that players can charge up the battery when running/jogging, or even throughout their daily tasks (i.e. walking, cleaning house...).

In stage 2, playing the board game was really complex due to the use of physical energy and to the diverse manipulations. There are many switches and buttons that can be confusing and energy can be lost when transferring from one battery to another.

Analytic Evaluation

Players should be able to apply, misapply or subvert the rules to win (Salen & Zimmerman, 2004); this is legitimately cheating.

This last evaluation actually allowed cheating as the levels of physical activity were self-reported but this would be different for a fully working prototype. However the game in stage 2 is based upon the quantity and quality of exercise stage 1 therefore more thoughts has to be made onto how stage 1 can influence stage 2.

Furthermore, fairness in stage 2 also needs reviewing. Even if the whole concept is about rewarding players doing more physical activity, the advantage gained in stage 1 shouldn't be fully certain for stage 2 and other players should be able to get back in the game. If the youngest player in the family generates the least energy in stage 1, winning the game becomes difficult, and he/she will get unmotivated and lose interest very quickly. There should be an element/square in the game that allows players swapping of circle as a way to maintain the uncertainty of winning, crucial element in a game play.

This lack of fairness is also partly due to the fact that the game play is mainly based on luck and players should be able to develop strategies to win. The definition of 'game play' is that a players' actions must change the actions of the other player, making him think of alternative moves, thus allowing players to develop new strategies (Salen & Zimmerman, 2004).

From the tests presented in this paper, Gener-G seems to have a viable working concept however many issues remain in terms of complexity of game play, fairness between all the players and the continuous dimension of gaming has to be more explored; repeated play hasn't been evaluated, partly due to the complex technology associated to it.

BEHAVIOUR CHANGE & GENER-G

Theories & Models

Effective interventions to promote physical activity should be based on psychological theories of behaviour change (NICE, 2003). A wide variety of theories and models have been generated to promote health. One commonly applied to Physical Activity is the Theory of Planned Behaviour (TPB) (Ajzen, 1991), which defines how attitudes can influence behaviour according to an individual's behavioural beliefs, Subjective Norm and Perceived Behavioural Control. The subjective norm refers to the perceived social pressure and models provided by significant others like family and friends to adopt or not adopt behaviour (Ajzen, 1991). Even if intervention based on the TPB is effective in an exercise context (Nahas et.al., 2003; Chatzisarantis & Hagger, 2005), it doesn't account for group level change. Besides, being primarily a model of intention formation, it doesn't ensure that intentions are turned into action (Sutton, 1998).

The TransTheoretical Model (TTM) is a model that describes the behavioural processes of change that have been regrouped into five stages to support individuals in the behaviour change process. It offers much potential and has commonly been applied to promote physical activity (Spencer et.al., 2006) however it has been highly criticised and needs more research (Hutchison et.al.,2008) and

evidence to suggest that the application of the model has health-related behaviours changes (Aveyard et.al.,2009), especially when used with adolescents (West, 2005).

Developed from the theory of motivation (Deci & Ryan, 2002), another important theory to consider is the Self Determination Theory (SDT), differentiating intrinsic and extrinsic motivation and suggesting how to move from extrinsic motivation to intrinsic.

Also, promoting physical activity should be based on multi levels interventions in four domains: recreation, transport, occupation (work/school), and household (Sallis et.al., 2006).

Gener-G and the Theories

Gener-G has obvious connections with the theories and models of behaviour change through elements that map onto experience of behavioural processes even if all of this was unknown when creating it.

Related to Sallis et.al. (2006)'s ecological model, Gener-G is a vehicle (game) that fits within a domain (household) using value (family) to engage with a topic (physical activity), which therefore uses key components for driving behaviour change. The context of home and the value of family are used to engage and bring people together around activity without activity being expressed purpose. Some players may not be motivated to do physical activity to improve their health but to play the game. They get a sense of efficacy from doing the activity to power the game and this is why it may also engage some players to resolve ambivalence they might have to change.

Gener-G is a way to engage players across all the spectrum of stages of change due to the family orientation of the game. People from different motivation stages are brought together and the game has the opportunity to challenge or reinforce them depending on where they are across the process. However Gener-G doesn't provide a staged-match intervention: it is not targeted at a specific individual at a specific stage, and it doesn't support individuals to plan behaviour.

Gener-G helps developing or reinforcing positive behavioural beliefs through playing the game; it has positive and direct benefits of doing physical activity through the use of rewards. This extrinsic motivation is a way to initiate or adopt a change in behaviour but other elements need to happen to maintain that change over a long period.

Gener-G therefore uses components of processes of change to enhance or support attitudes and beliefs, and to create a social norm around exercise while increasing physical activity, component of the game.

WHAT'S NEXT

From the Feedback

As an alternative to be more accurate in the simulations and to avoid complex manipulations in stage2, the game could be developed without real energy, using pedometers instead. This could measure levels of physical activity to be converted into points for stage 2. However it would still be easy to cheat by attaching pedometers onto the dog, making the legitimate cheating 'illegitimate'...

More fundamentally, this board game illustrates one way to play one type of game, in the family environment, but this was all conceived and developed without any knowledge or structure. The added knowledge of behaviour change theories as well as investigating young people might now open up different possibilities and dimensions in game play.

The Research

There is a need to better understand the end-users to find out what is relevant and appropriated so that they will be attracted and engaged by the game over a long term period.

Since the creation of Gener-G, a participatory approach with young adolescents (11-12 years old) has been taken forward to investigate their taste and lifestyle to create a new game design, more appropriate and acceptable. This enabled the researcher to explore more about the game/gaming

aspect in the adolescents' lifestyle, where there is the possibility for game(s) to fit, which type, who with… This study has revealed that young adolescents are actually more motivated when playing with their peers rather than their family but it has also shown that orienteering games seem to be an area to investigate further.

As demonstrated in this paper, it is through the making of games that designer/researcher can develop a project further which is the aim of the next case study; combining the understanding gained during the pilot studies with the theories and models of psychology of behaviour change, game concepts are being generated and will be tested in another secondary school.

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